



Over 50 Successful Launches: Priceless

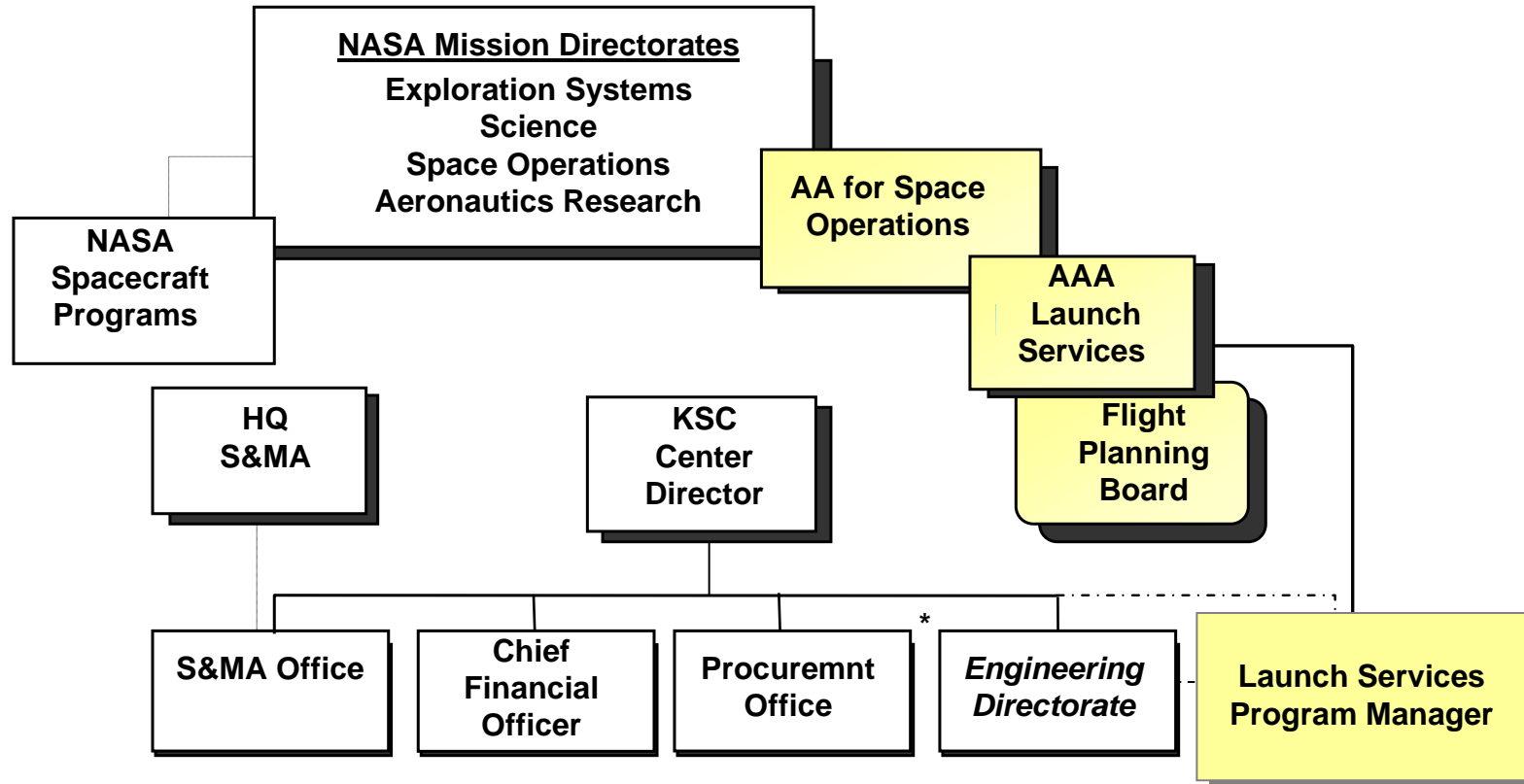
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Flight Projects Office*



Launch Services Program

John F. Kennedy Space Center

LAUNCH SERVICES PROGRAM



*New Technical Authority Relationship with LSP as of 10-1-06

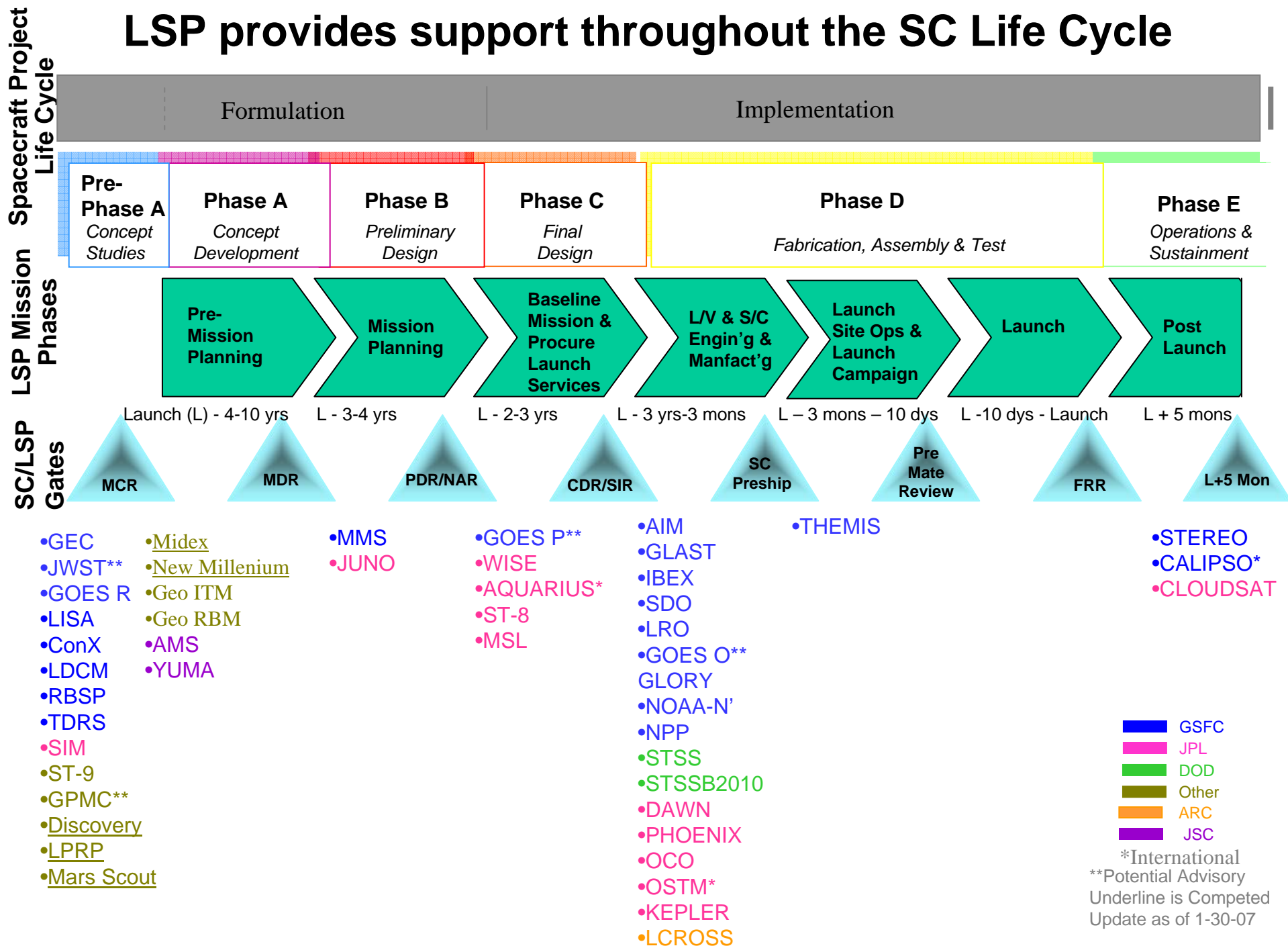
Interface with other NASA Centers

GSFC/WFF
Educational
Payloads

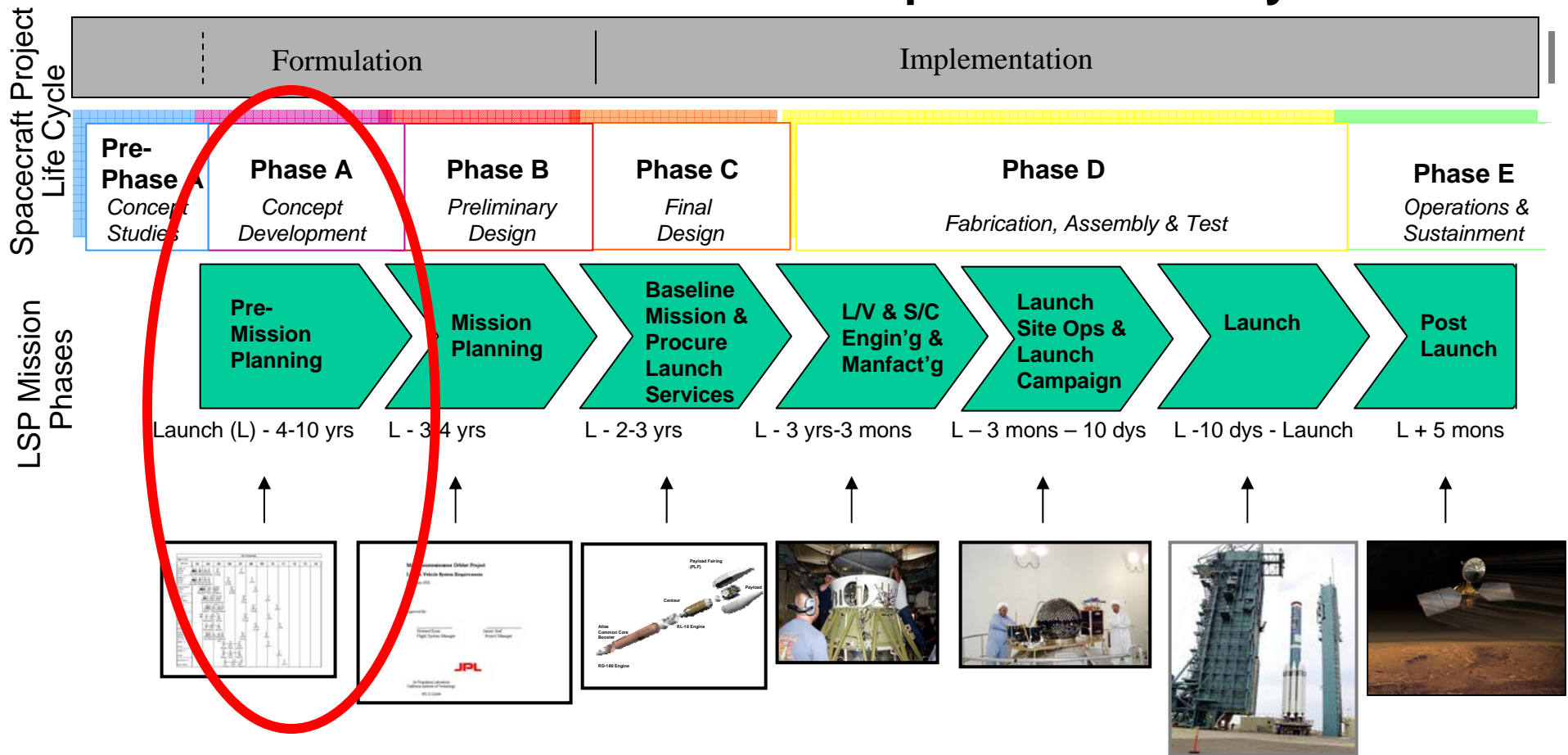
MSFC
ELV Support

SSC
ELV Support

LSP provides support throughout the SC Life Cycle



NASA Launch Services and Spacecraft Life Cycles





Mission: SWIFT

John F. Kennedy Space Center

LAUNCH SERVICES PROGRAM

Introduction:

- 2 year mission, first-of-its-kind multi-wavelength observatory dedicated to the study of gamma-ray burst (GRB) science

Timeline:

- SWIFT was built in the “Better, Faster, Cheaper” era and had begun to build “easy” interface hardware prior to engaging the Launch Services Program (during Pre-Mission Planning Phase).

Problem:

- SWIFT built their payload adapter using a Boeing Payload Planner’s Guide
- This guide was an old version that had an incorrect drawing in it resulting in the spacecraft side of the adapter being too thick.

Other occurring issues:

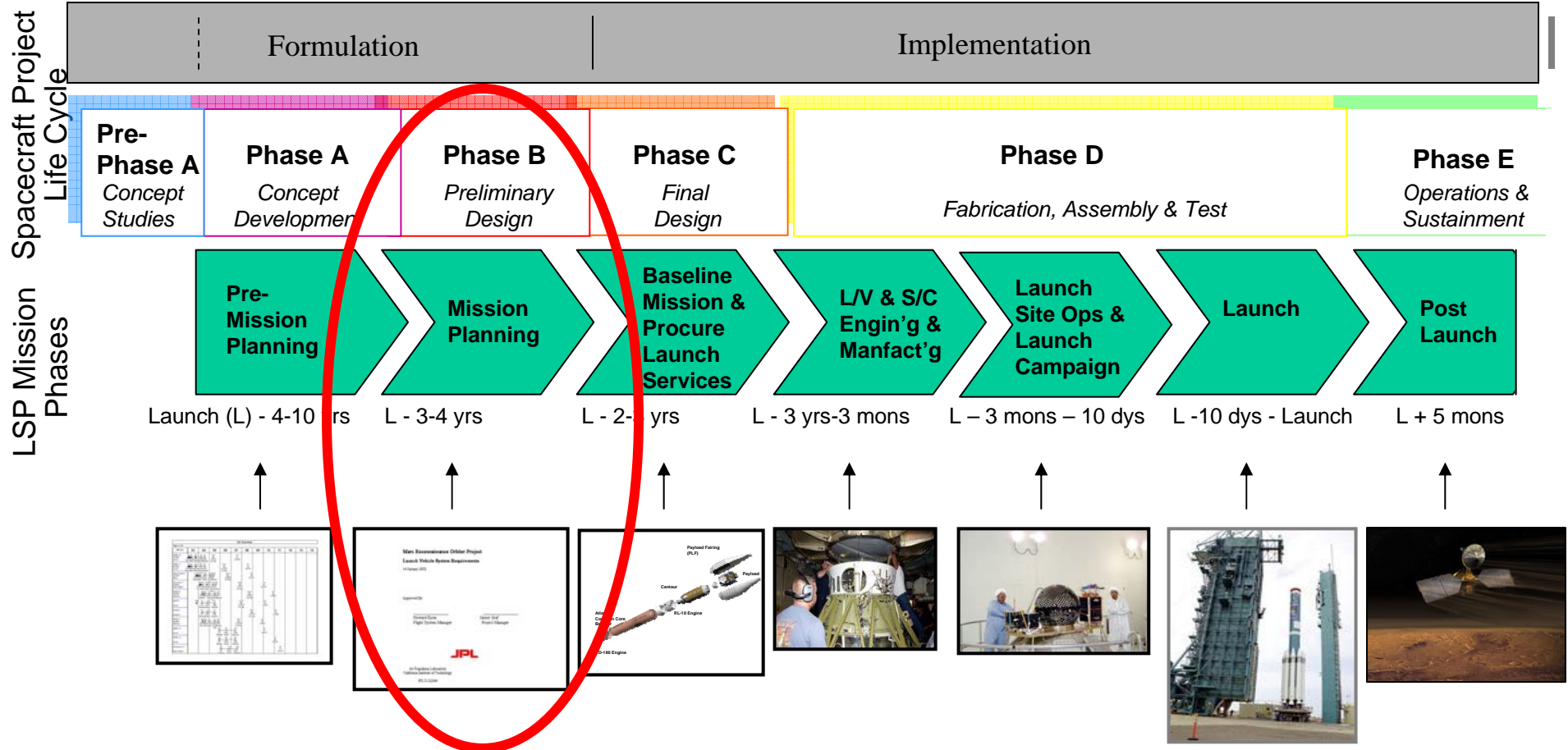
- The launch vehicle side of the interface was modified to accommodate; however, this was expensive and forced the use of the flight adapter for vibe testing.
- And now PAF was first flight!

Immediate/long term Mitigation:

- Alerted next mission with the same bus (STSS Block 2010) and informed GSFC/JPL
- LSP must actively engage all missions earlier
- Identify early and communicate often the discontinuities between contractor payload planners guides and the NASA Launch Services (NLS) Contract
- Promote synchronization of deliverable schedules, both launch vehicle and spacecraft, and share areas of flexibility. Assists in creating better spacecraft subcontract definition...and eliminates some surprises



NASA Launch Services and Spacecraft Life Cycles



High Level Description

- Initial vehicle trade studies conducted
- Spacecraft Preliminary Design Review (PDR), Mission Confirmation Review (MCR)
- Spacecraft Interface Requirements Document (IRD) developed
- Vehicle acquisition strategy agreed upon
- Safety Working Group established

Major Product:
Spacecraft/Vehicle requirements baseline



Mission: SPIDR

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LAUNCH SERVICES PROGRAM

Introduction:

- SPIDR's mission was to answer fundamental questions concerning the formation and evolution of galaxies, clusters of galaxies, and other large structures in the universe

Timeline:

- Mission selected from AO 7/02; Mission Planning Phase
- Launch Service was ATP'ed on 12/02 (prior to s/c Confirmation Review) with launch date of 6/30/05
 - Early ATP was authorized to take advantage of lower contractual launch service cost (CY02 vs CY03).

Problem:

- SPIDR mission did not get confirmed; launch service was on contract

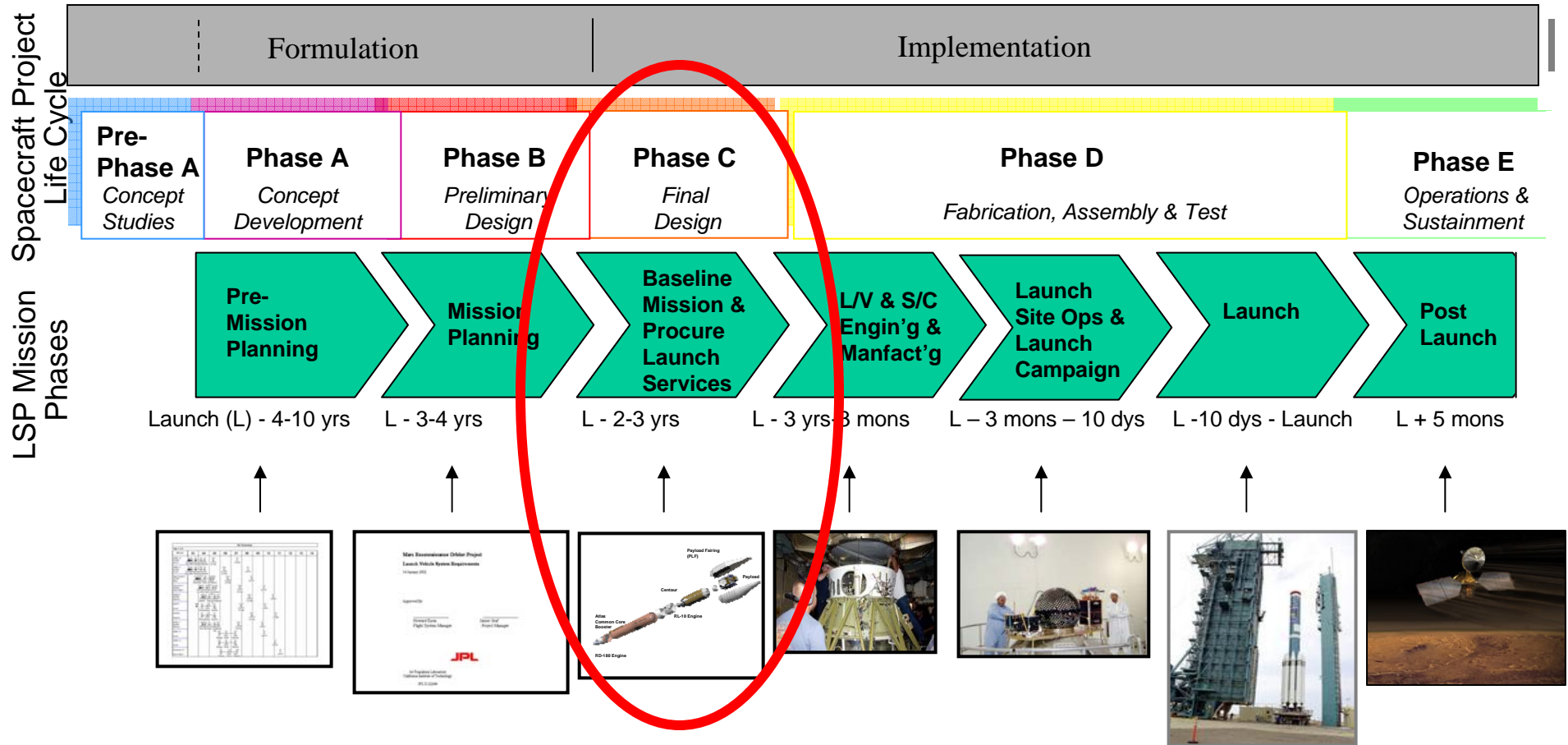
Other occurring issues:

- Shortened mission timeline had Confirmation Review after L-24 months. Initiation of launch service after L-24 would have cost significant \$.

Immediate/long term Mitigation:

- LSP negotiated an "Advance Agreement on Mission Revisions" into the SPIDR Task Order
 - Allowed reassignment of launch service.
 - Tailored payment schedule to move primary payments after Confirmation Review
- AIM mission was replacement for SPIDR. AIM launch date was September 29, 2006
 - No additional cost to AIM and AIM got benefit of L-35 ATP for same price as nominal integration
- Heightened awareness of need for significant coordination prior to initiation of launch service
- Engage LSP early so that we can work together to maximize flexibility and minimize risk . **Early involvement improves capability to address challenges faced in launch service acquisition**

NASA Launch Services and Spacecraft Life Cycles



High Level Description

- LSP competes launch services (vehicle)
- Flight Planning Board reconfirms launch date, provides authority to proceed, concurrence with recommended vehicle services contractor selection
- Program Requirements Control Board (PRCB) approves ATP of mission
- Spacecraft Critical Design Review (CDR) is held
- Launch service budget may be revised based on outcome of procurement
- Extensive Mission Integration Working Group (MIWG) activity, involving spacecraft and LSP personnel

Major Product:
Mission Design
and Launch
Service Task
baselines



Mission: LRO/LCROSS

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LAUNCH SERVICES PROGRAM

Introduction:

- LRO/LCROSS - Secondary mission was desired by the customer to use excess EELV performance capability.

Timeline:

- During launch services competition (~2 1/2 years prior to launch)

Problem:

- LCROSS mission was solicited and selected after the launch service procurement had begun for LRO

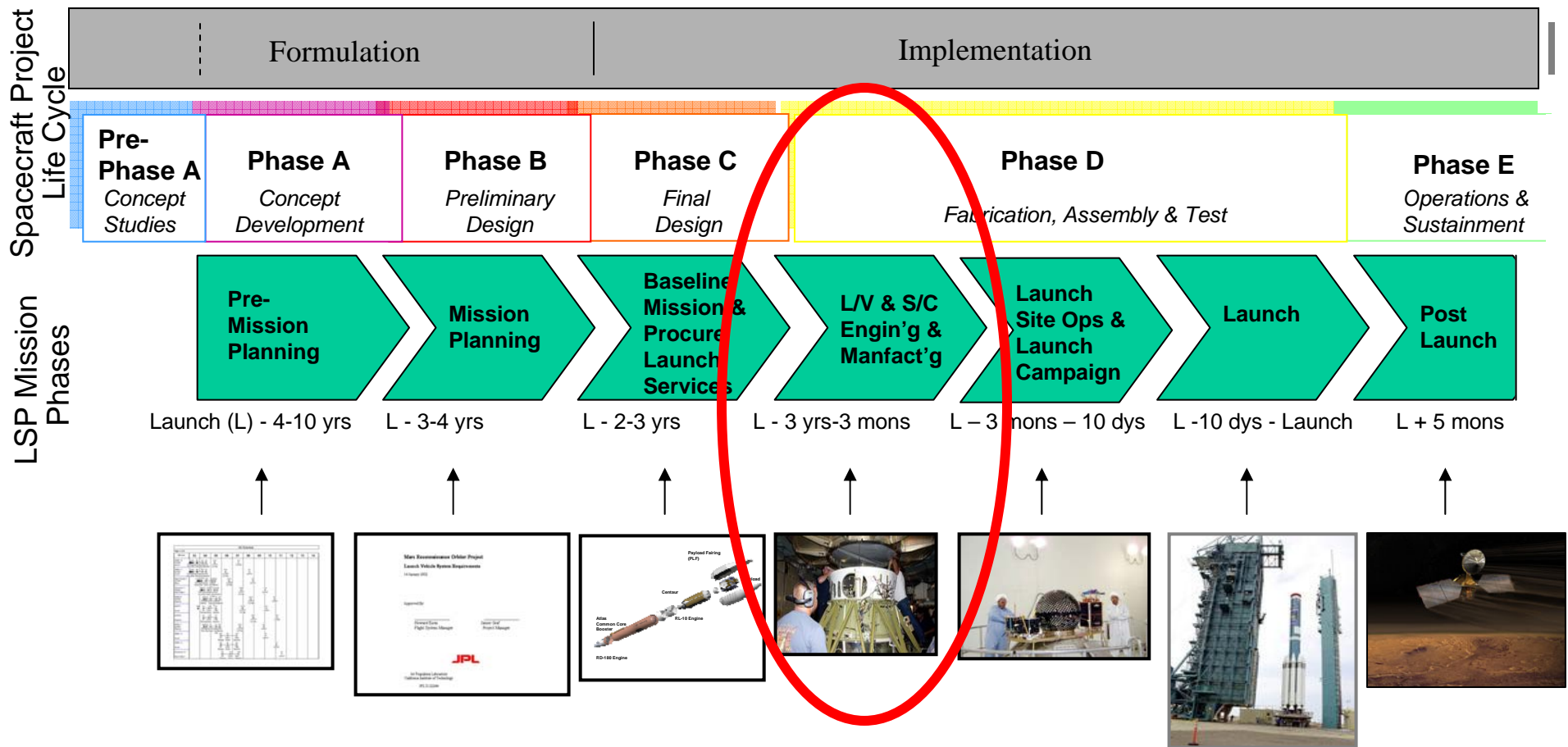
Other occurring issues:

- Quick turn around on competitive procurement for complex secondary mission
- LRO already fell within shortened integration timeline for large class vehicle

Immediate/long term Mitigation:

- Incorporated late breaking requirements
- ESMD customer involved LSP early in the selection process for the secondary to ensure compatibility between payloads prior to selection
- Preparation and coordination allowed LCROSS to be added without re-bid
- Knowledge of contractor capabilities, late breaking mission requirements, experience with dual manifest missions allowed smooth incorporation
- Encourage participation from SC community in vehicle procurement process to ensure mission requirements are understood and met.

NASA Launch Services and Spacecraft Life Cycles



High Level
Description

- Extensive Working Group activities
- Updated Interface Control Document (ICD) baseline and baselined Launch Site Support Plan (LSSP)
- Spacecraft and Launch Vehicle hardware in build and testing
- Vehicle Hardware Acceptance Reviews
- LSP ensures launch site facilities/services are ready for spacecraft arrival; Ground Operations Review (GOR) conducted by LSP for customer
- Safety & Mission Assurance review; Pre-launch safety packages approved for spacecraft arrival

Major Product:
Spacecraft & vehicle ready to begin launch site operations and integration



Mission: MESSENGER

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LAUNCH SERVICES PROGRAM

Introduction:

- Mercury Surface, Space, Environment, Geochemistry, and Ranging, is the first scientific investigation of the planet Mercury from orbit.

Timeline:

- Less than 6 months from launch

Problem:

- The MESSENGER mission had changed its launch date. This resulted in changing its mass properties, desired propellant load and tank fill fraction. The new propellant load was not adequately bounded by nutation time constant testing performed years earlier which was used to define adequate fuel tank baffle and vortex dampers.

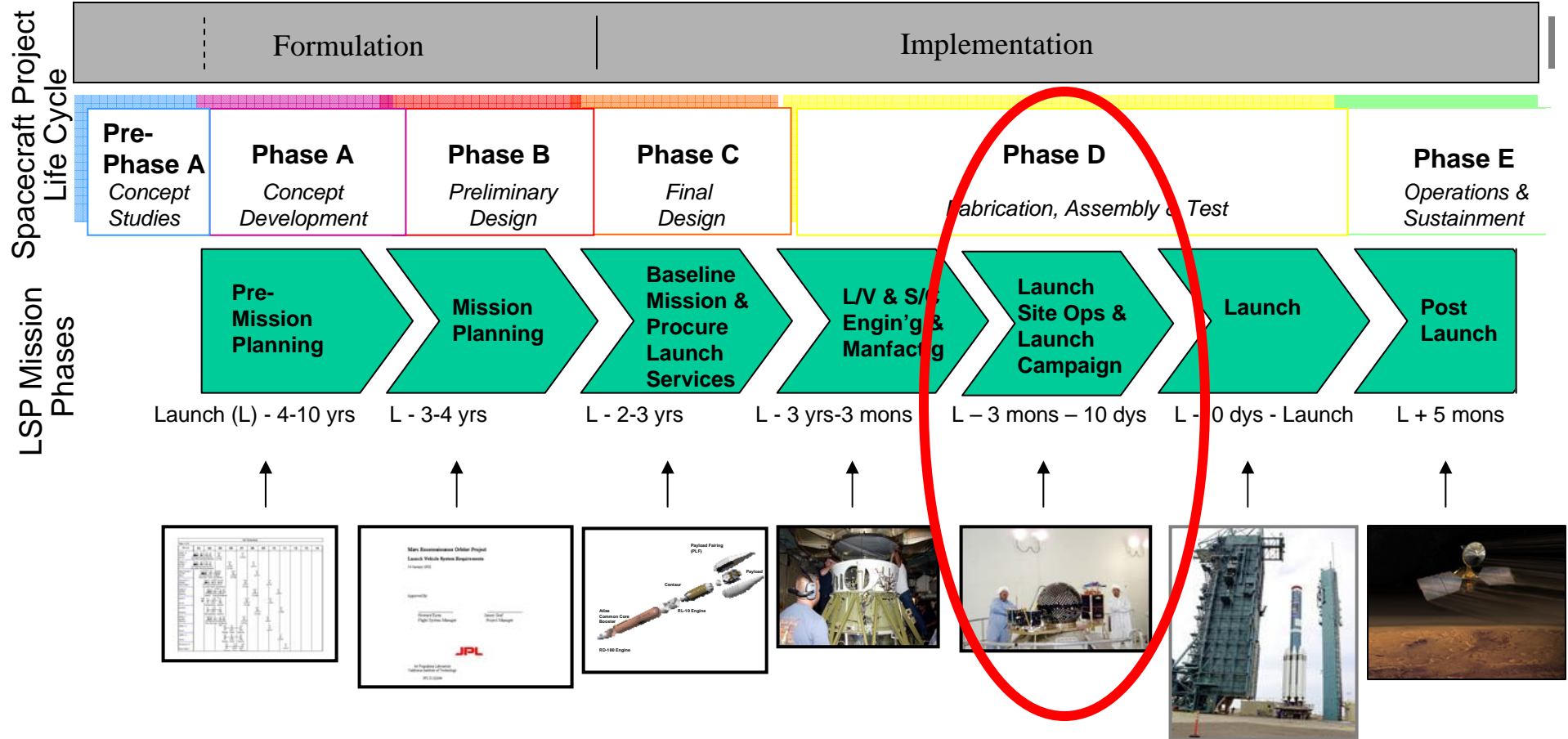
Other occurring issues:

- The spacecraft was at the launch site and scheduled to be fueled within months
- Trajectory design was modified to accommodate the different launch period requiring more fuel and higher fill fraction
- Re-test was recommended to the spacecraft

Immediate/long term Mitigation:

- The spacecraft conducted additional drop test which yielded a modification in the allowable propellant load to ensure vehicle controllability and bounded target dispersions.
- Actively applied to all spin stabilized missions with high spin rates. LSP has contracted with Hubert Astronautics to develop a design guidelines book for spacecraft developers. The original book, Behavior of Spinning Space Vehicles with Onboard Liquids, was published in August 2003 by Hubert Astronautics

NASA Launch Services and Spacecraft Life Cycles



- Spacecraft Pre-Ship Review (PSR)
- Spacecraft and Ground Support Equipment (GSE) arrive at launch site
- Complete spacecraft pre-mate assembly and testing
- Complete Range Safety (USAF) Review package
- Integrate spacecraft to launch vehicle and perform testing
- Launch Vehicle Readiness Review (LVRR)
- Spacecraft Mission Readiness Review (MRR)
- Independent Safety & Mission Assurance Readiness Review (SMSRR)
- Spacecraft participates in mission success letter for launch service

Major Product:
Mission Team,
including spacecraft
and LSP ready to
proceed to Launch Phase
and Launch



Mission: MRO

Introduction:

- Mars Reconnaissance Orbiter (MRO) was the first NASA mission to launch on Atlas V vehicle

Timeline:

- Spacecraft closeouts the weekend prior to the scheduled launch

Problem:

- Condensation discovered within the fairing and surrounding spacecraft instruments leading to one of the primary science instruments, the HIRISE camera, experiencing fogging of its lens.

Other occurring issues:

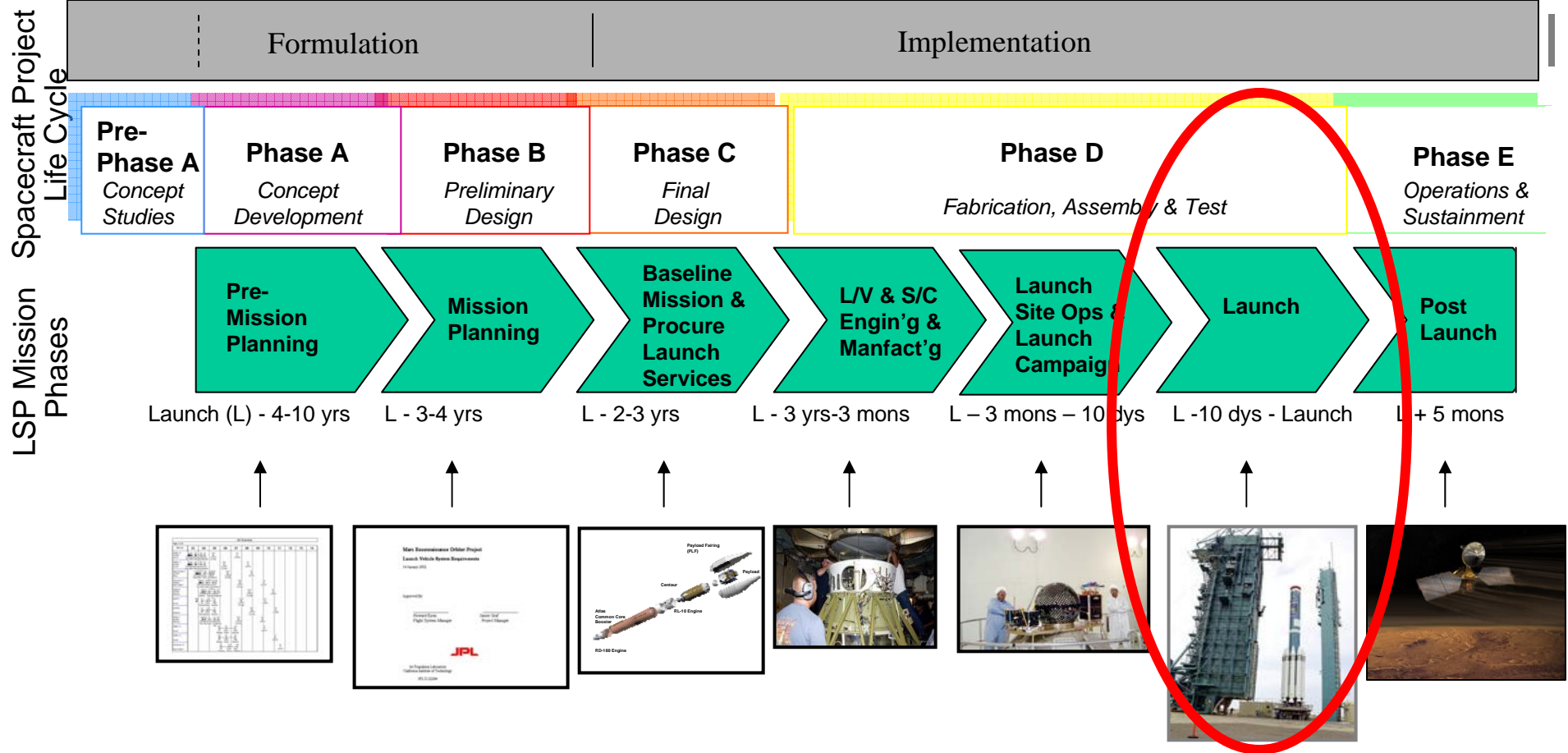
- Other issues/activities were ongoing and access was required
 - Fire alarms at the Vertical Integration Facility
 - Multiple Flight Termination System battery failures
 - Spacecraft propellant line heating concerns

Immediate/long term Mitigation:

- Developing an integrated door control access plan and manage dual/parallel close timelines for both spacecraft and launch vehicle.
- Actively applied to MSL mission during the procurement phase as well as Phoenix, launching this year.



NASA Launch Services and Spacecraft Life Cycles





Mission: NOAA-L

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Introduction:

- NOAA-L spacecraft launched on a Titan II provided by the USAF

Timeline:

- Day of launch with a 10 minute launch window

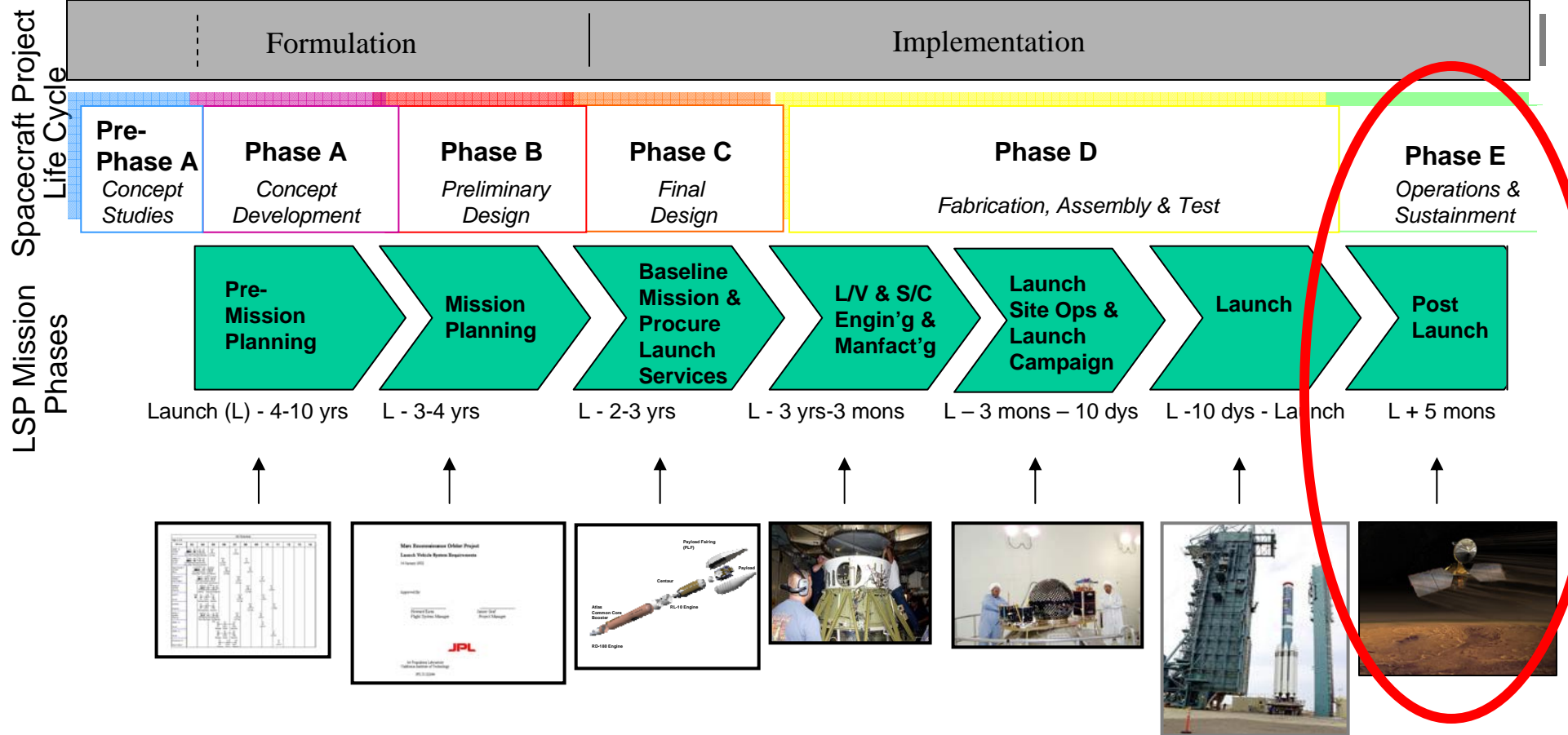
Problem:

- Launch was not “typical” for a NASA mission-- vehicle owned by the Air Force.
- The countdown was behind the timeline, due to a later than normal mobile service tower roll.
- An issue surfaced involving the validity of the inertial navigation units calibration data.
- The countdown continued while discussions regarding this anomaly occurred on NASA, AF, and LMA channels. After long deliberations, LMA and the AF determined that the navigation unit was flight worthy and that launch vehicle was ready.
- NASA team was not ready to commit to launch. Additional anomaly net discussions continued but it became apparent to LSP that there were too many questions still unresolved coupled with a countdown that had been fragmented and appeared to be "rushed".
- It was determined by LSP that this was not the day to try to launch the NOAA-L spacecraft and a NO GO was called at about T-10 minutes.

Immediate/long term mitigation:

- LSP worked closely with their customer as well as the Air Force and Lockheed Martin during entire anomaly discussion, and although the NO GO call was not unanimous, it was well understood by all agencies.
- This scrub call validated the processes that LSP uses every launch day. Even with the non-standard approach of having NASA, the USAF, and a launch service contractor involved, the communications flow-down of the entire team worked very well and the process exhibited robustness.
- Thorough coordination meetings and dress rehearsals continue to be held for every NASA mission

NASA Launch Services and Spacecraft Life Cycles



- Launch site close-out activity
- Spacecraft effort transferred to operations control center
- Post-launch flight reports

Major Product:
Mission Success
Determination



Mission: DART

John F. Kennedy Space Center

LAUNCH SERVICES PROGRAM

Introduction:

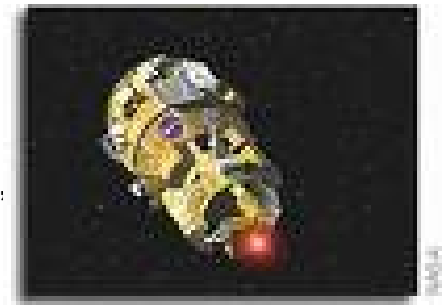
- Demonstration of Autonomous Rendezvous Technology (DART) was a 24-hour mission to demonstrate technologies required to locate and autonomously rendezvous with another craft in space using only computers and sensors

Timeline:

- On orbit operations

Problem:

- After a successful rendezvous, acquisition of the target spacecraft, and approach, DART placed itself in the retirement phase before completing all planned proximity operations, ending the mission prematurely.



Other occurring issues:

- Launch occurred from Vandenberg AFB
 - Most launch team traveled home after successful launch and many could not be contacted
- Effectivity of LSP Contingency Plan had expired

Immediate/long term Mitigation:

- The LSP Interim Response Team members contacted and instructed to impound launch vehicle data to support investigation
- LSP contingency plan was modified and effectivity was extended to 24 hours after successful separation of the spacecraft. This allows rapid impoundment of launch vehicle data if required by the spacecraft during early on orbit operations
- Key personnel are required to remain in contact through this 24 hour period



In Closing....

- Launch Services Program (LSP) brings experience from NASA's expendable launch vehicle fleet and launch site processing facilities combined with spacecraft interfaces
- LSP is implementing a new **lessons learned** process to capture and share the knowledge that will improve service to customers
- The goal of the Launch Services Program is to increase mission success through strengthened customer relationships from early involvement in spacecraft missions through to launch

Learning from the past, engaging in the future...

